The Open Journal of Occupational Therapy

Volume 1
Issue 3 *Spring 2013*

Article 2

June 2013

Grip and Pinch Strength Norms for Michigan Workers

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Recommended Citation

Phillips, J. M., Lindstrom-Hazel, D. K., Harrow Swantek, S., & Courtnay Catalano, E. (2013). Grip and Pinch Strength Norms for Michigan Workers. *The Open Journal of Occupational Therapy, 1*(3). https://doi.org/10.15453/2168-6408.1038

Grip and Pinch Strength Norms for Michigan Workers

Abstract

The purpose of this study was to create a norm reference of current grip and pinch strength norms for working-age Michigan adults. This normative study included a convenience sample of 179 volunteers who were employees at car plants in South East Michigan or hospital sites in West Michigan. Participants' ages ranged from between 20 and 62 years of age with a mean age of 49.15 years. There were 78 females (44%) and 101 males (56%). Subjects were classified by gender and in the age categories of ages 20 to 49 years and ages 50-62 years. Grip and pinch strength norms were collected following the American Society of Hand Therapy protocol. The norms from these working adults were calculated with descriptive statistics for males and females in two age classifications: ages 20 to 49 and ages 50 to 62 years. Standard Errors (SE) are better than the 1985 norms for both males and females ages 20 to 49 years. SEs are higher than the ages 20 to 49 years' norms for the ages 50 to 62 years age categories in both males and females. These norms offer a point of comparison for clinicians to use for clients in Michigan who are ages 20 to 62 years and who have a goal to improve their grip strength. Clients' grip and pinch strength could be compared to their age level or gender norms using the comparison for one standard deviation above, below, or at the means.

Keywords

grip strength, pinch strength, occupational therapy, normative data, key pinch, mobile device, work

Cover Page Footnote

The authors wish to acknowledge the participants in the study as well as Ashley Thompson and Angela Moran, who assisted with data entry and analysis, and Stacy Froseth, Tina Caruso, and Rachel Iott who participated in data collection.

Credentials Display and Country

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DOI: 10.15453/2168-6408.1038

Hand use in the United States has changed since 1985, when Mathiowetz et al. (1985) conducted the last large norm study in the US. At this time, many people were just beginning to use personal computers in their homes (Computer Hope, 2013), only a small percentage of the adult population owned cell phones (CTIA Wireless Association, 2013), and video games were just becoming available on the personal computer (Infoplease, 2007). Even though we use our hands differently in many ways now from how we used them 30 years ago, we still need hand strength for daily living tasks, such as opening jars and holding onto bags to carry into the house. Grip strength is an important underlying component necessary to carry out our daily living tasks, and establishing current norms is crucial to ensure comparison is in alignment with providing evidence-based practice (Kolber & Cleland, 2005).

Just as our communication devices (cell phones and computers) and leisure options (video and computer games) have evolved since 1985, many jobs in the US have transitioned from physically demanding tasks (requiring strength and coordination) into more compartmentalized manufacturing and office or desk jobs with different types of demands. Between 1980 and 2000 there was a significant increase in the number of professional and technical workers and a decrease in the number of craftsmen and production workers. The number of general laborers and farm laborers also decreased significantly during the twentieth century, but the sharp decline in these jobs occurred prior to 1980 (Wyatt & Hecker, 2006). It is very important for occupational therapists (OTs) to measure a person's grip and pinch strength if, in fact, a deficit in strength is restricting occupational tasks and activities that are important to the individual. The dynamometer and pinch gauges have been established as reliable tools for measuring strength if they are calibrated and set to 0 prior to the person gripping the instrument (Flinn, Trombly Latham, & Robinson Podolski, 2008). In alignment with the professional policies for using current scientific evidence to guide practice (AOTA, 2005), grip and pinch strength measurements need to be valid and reliable to be considered acceptable practice in the evidence-based practice environment.

Validity and Reliability of Norms

A commonly accepted procedure for measuring grip and pinch strength is using handheld dynamometers and pinch gauges (Fess, 2002; Kolber & Cleland, 2005; Peolsson, Hedlund, & Oberg, 2001). These devices are easy for therapists to use (Bohannon, 1999), and readings by different raters have been proven reliable when researchers follow the American Society of Hand Therapists (ASHT) standard protocol and raters receive training in reading the gauges accurately (Lindstrom-Hazel, Kratt, & Bix, 2009; Sebastin, Lim, Bee, Wong, & Methil, 2005). These interrater reliability studies support the use of students, non-health care professionals, and therapists to collect the strength measurements, but examination of the

validity of the norms used for comparison regarding geographic relevancy is necessary.

Geographic Validity of Current Norms

Administering grip and pinch strength allows for comparison of hand strength improvement over time, but also may be clinically helpful for comparison of a client's strength to relevant norms in order to understand how they compare to others from a similar population. Researchers across the globe have attempted to create norms to help serve as a standard for comparison (Gunther, Burger, Rickert, Crispin, & Schulz, 2008; Kunelius, Darzins, Cromie, & Oakman, 2007; Mathiowetz et al., 1985; Mitsionis et al., 2009; Peolsson et al., 2001), but there are discrepancies concerning what is currently the "best" and most applicable set of norms to use. The current standard of practice in the United States is to use the norms collected by Mathiowetz et al. (1985) in Minnesota following the ASHT protocol, even though these norms are now 28 years old.

Geographic-specific norms have been collected within the last 10 years in Germany (Gunther et al., 2008), Sweden (Peolsson et al., 2001), Greece (Mitsionis et al., 2009), and Australia (Kunelius et al., 2007). Researchers compiled these international norms through a meta-analysis to make them available for use throughout the world (Bohannon, Peolsson, & Massy-Westropp, 2006). The researchers collected these norms following the ASHT protocol (Fess & Moran, 1981); however, they include norms collected over a more than 20-year period (1985-2006). The 2007 Australian study examined hand strength and anthropometric dimensions for autoworkers in Australia. This study found that there were significant hand strength differences between their Australian sample and the commonly used norms (Kunelius et al., 2007). If differences do exist in hand strength from different geographic locations, combining the norms from various locations would not be valid for comparisons. Specific geographic norms may be necessary because of the difference in grip strength in different geographic locations. Studies with a limited geographic scope (Gunther et al., 2008; Kunelius et al., 2007; Mitsionis et al., 2009) have been critiqued in the past due to the geographic limitation; however, because of differences in grip strength in various geographic locations, this may actually provide the most valid comparisons. Another difference among these international studies is the age categories used for comparison.

Categories for Norm Comparisons

All of the previously published norm studies have categories for gender and hand use, but the age categories were either 5- (Bohannon, Peolsson, Massy-Westropp, Desrosiers, & Bear-Lehman, 2006; Mathiowetz et al., 1985; Mitsionis et al., 2009) or 10-year groupings (Gunther et al., 2008; Kunelius et al., 2007). The first large, hand strength norm study (collected in MN, USA), found that both male's and female's grip strength peaked between the ages of 25 and 50 years (Mathiowetz et al., 1985). This finding was supported in a Greek study, which found that after the age of 50 years most people experienced a decrease in grip strength (Mitsionis et al., 2009). The German norms divided the categories by decades (20 to 29, etc.) and the

decline in strength occurred after the age of 49 years for both males and females (Gunther et al., 2008). A study conducted in Sweden found that gender was the most important determinant of hand strength (more so in regard to the dominant vs. non-dominant hand) (Peolsson et al., 2001). The 5- and 10-year categories for adults between the ages of 20 and 49 years and 50 and 65 years (working- age adults) did not have significant differences between the sequential age categories, but researchers observed decreases in strength after the ages of 49 and 50 years (Mathiowetz et al., 1985).

Current practice validity

One recent study (Kunelius et al., 2007) found a significant difference between the strength of Australian automotive trim line workers and the Mathiowetz et al. (1985) norms. The purpose of the Australian study was to determine the best fit of the tools used on the trim line and the workers' anthropometric data and strength. This example of the difference between grip strength on two continents and over 20 years indicates the need for recent and geographic norms for valid comparison when making worker-related decisions based on the workers' expected grip strength.

General norm validity literature suggests that norms should be evaluated and/or updated every 10 to 20 years to determine if the norms are still valid (Stringer & Nadolne, 2000). Researchers designed this study to collect the data of grip and pinch strength for working-age adults from two different types of settings and geographic locations in MI, USA.

Method

Participants

Researchers recruited the participants at their places of employment during their break or lunch times. Participants were offered a small incentive for taking part in the study. All participants reported that they were free of any upper extremity pain or working restrictions.

Procedures

A university and hospital Human Subjects Institutional Review Board as well as the management at all settings and the union at the automotive plants approved this study. Data collectors conducted brief interviews with the participants after receiving informed consent for participation in the study. Data collection in this study also included the participants completing the assembly task of the Purdue Pegboard (publication forthcoming), which occurred at the conclusion of the grip and pinch testing.

Equipment

A standard adjustable-handle Jamar dynamometer, a hydraulic tool commonly used in OT to assess grip strength (Flinn et al., 2008), was used for grip strength testing, with the handle set at the second position for all participants (Figure 1). This second position, or "position 2," is recognized as the standard testing position based on maximum effort and the mechanical advantage of the hand (Fess & Moran, 1981). This position on the dynamometer was used as a standard practice for both males and females and participants with varying sizes of hands. A B&L pinch gauge, a hydraulic tool used to assess different types of pinch

in OT (Flinn et al., 2008), was used for both lateral (Figure 2) and 3-jaw chuck trials.

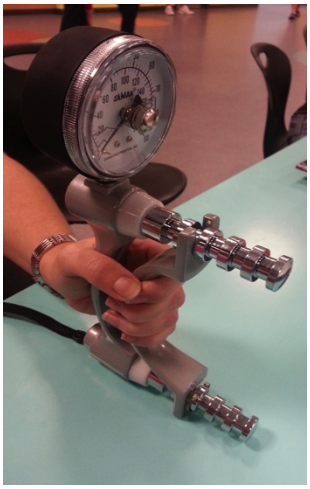

Figure 1. A standard adjustable-handle Jamar dynamometer used for grip strength testing, with the handle set at the second position for all participants.

Figure 2. A B&L pinch gauge used for both lateral and 3-jaw chuck trials.

InterRater Reliability

The authors of this study, who were all experienced OTs and had demonstrated competency in administration and scoring prior to data collection, trained the student raters. Raters were only allowed to collect data after their interrater reliability scores were above a .95 Intra-Class Correlation Coefficient (ICC) with the trainer. The ICC is typically the ratio of the variance of interest over the sum of the variance of interest plus error. The ICC provides a more reliable measure of consistency between raters than does a linear relationship correlation statistic, such as a Pearson correlation (Shrout & Fleiss, 1979). In an earlier published study, four student raters in six different "teams" who were trained by the same procedure for administration of the grip and pinch testing were found to have an ICC that ranged from .996 to .998 for the Jamar dynamometer; ICC scores ranged from .951 to .993 for key pinch and from .944 to .988 for 3-point pinch readings for those six teams of student data collectors (Lindstrom-Hazel et al., 2009).

Data Collection Procedure

Following the initial interview, the student researchers administered the grip strength testing with a Jamar dynamometer and then key pinch and 3-point pinch with a B&L pinch gauge. All of the grip and pinch testing was conducted in the standard testing position approved by the ASHT (Fess & Moran, 1981). Participants were seated in a straight-backed chair with both feet flat on the floor and the shoulder adducted and neutrally rotated. The elbow was flexed at 90 degrees, the forearm neutral, and the wrist between 0 degrees and 30 degrees extension and between 0 degrees and 15 degrees ulnar deviation. The arm should be independently held in space rather than supported on an armrest or by the examiner. The student researchers handed the dynamometer to the participant three times for each hand. The

participant began by holding the dynamometer in their left hand and squeezing the handle that was set in the second position. Each participant was asked to squeeze the dynamometer with the left hand, after which the score was recorded, and then the instrument was taken and handed to the participant in their right hand and they were again asked to squeeze the dynamometer; that score was recorded. Participants repeated this sequence two more times with each hand, for a total of three trials for each hand in the alternating pattern. Pinch strength was then tested in the same trunk and arm position with the pinch gauge held in a lateral position (forearm in neutral) for the key pinch, and then the forearm was in a pronated position with the pinch gauge upright for the 3-point pinch. The student researchers supported the pinch gauge while the participants squeezed the instrument. Researchers used the same alternating pattern to conduct pinch attempts to collect three trials for each position. The averages of the three trials for each of the instruments served as the norm calculations.

Scoring

Specific scoring procedures were followed to maximize the interrater reliability between the student researcher raters. Gauges were always read to the next higher marking if the needle fell above a mark in order to minimize errors if readings were estimated. Student researchers always reviewed the instruments prior to data collection in order to familiarize themselves with the pounds vs. kilogram markings on the instruments (Lindstrom-Hazel et al., 2009).

Data Analysis

Data analysis was conducted using the Analysis Tools in Excel for descriptive statistics with the probability level set at .05. Categories were developed for gender and hand used for grip based on differences highlighted in the literature (Hanten et al., 1999; Kunelius et al., 2007; Mathiowetz et al., 1985; Mitsionis et al., 2009). Since there was not a consistent correlation between specific ages and grip strength in the literature except that decreases occurred about the age of 50 years (Mathiowetz et al., 1985; Mitsionis et al., 2009), we divided the working population norms into two categories: between the ages of 20-49 years (taking into account that different people's strength peaked at different times and that there were not consistent differences between norms for people in the age groups below 50 years) and between the ages of 50-65 years for both males and females. We created these categories to reflect the decline of strength with age findings from norm studies since 1985. There is not a consistent trend in the literature for a strong correlation between age and hand strength except that strength peaks between the ages of 20 and 49 years (Mathiowetz et al., 1985). Using one mean for the entire age category better represents the general strength expected at any given age between the ages of 20 and 49 years, and minimizes the fluctuating of means between the progressively older-age categories that exist in the 1985 norms in 5-year categories.

Results

Subjects

The convenience sample consisted of 179 volunteers who were employees at either one of three mid-western car plants (suburban areas) or one of five sites for one metropolitan hospital (urban areas). The car plant employees worked at an axel plant as assembly line workers (assembling parts of varying sizes and weights using ergonomic tools and lifting devices while in the process maintaining productivity standards), white collar workers or engineers of an axel plant (using computers), or support staff of a car plant (cleaning and kitchen staff who used common tools in those areas). The hospital employees included therapists (OTs, PTs, OT Assistants, and PT Assistants) as well as secretarial staff (predominately administrative jobs that include writing and using computers and telephones).

Ages ranged from 20 to 62 years of age with a mean age of 49.15 years. There were 78 females (44%) and 101 males (56%). One hundred and fifty-five people (87%) reported being right hand dominant, 17 people (9%) reported being left hand dominant, and 7 people (4%) reported being "ambidextrous". The reported ethnicity was predominately White, not Hispanic (77%); 11% reported being Black, not Hispanic; 5% reported being Hispanic; 5% reported being "other;" and there was one participant in each of the remaining categories: American Indian, Asian, and Multi-ethnic. All participants reported that they were free from any upper extremity pain throughout the testing. See Table 1 for the age breakdown by 10-year categories and by grouped categories (20 to 49 and 50 to 62 years of age).

Norms for grip strength in the 20 to 49 years of age and 50-62 years of age categories are compared with the 1985 norms (Mathiowetz et al., 1985) in Tables 2 and 4. Tables 3 and 5 compare the study's norm findings with the 1985 norms (Mathiowetz et al., 1985) for key and 3-point pinch strength. Tables 6 and 7 give concise charts of this regional data to use for male and female hand grip strength norms, 3-point and key pinch strength in the 20 to 49 and 50 to 62 years of age gender-specific age categories.

Table 1

Subject Ages

Ages	Total	Females	Males
10-year categories			
20-29	40	23	17
30-39	47	17	30
40-49	43	24	19
50-59	45	11	34
60-62	4	3	1
Grouped categories			
20-49	130	64	66
50-62	49	14	35

Table 2
Males' Grip Strength Mean Comparisons 1985-2013 MI Norms

	1985 U.S. Means and (+- 1 *SD*)	**MI 2013 Means and (+- 1 *SD*)**	**1985 U.S. SE**	**MI Norms SE**
Males 20-49 R Grip				
20-24	121.0 (100.4-141.6)	120.2 (99.9-140.5)	3.8	2.5
25-29	120.8 (97.8-143.8)		4.4	
30-34	121.8 (99.4-144.2)		4.3	
35-39	119.7 (95.7-143.7)		4.8	
40-44	116.8 (96.1-137.5)		4.1	
45-49	109.9 (86.9-132.9)		4.3	
Males 20-49 L Grip				
20-24	104.5 (82.7-126.3)	115.0 (95.7-134.3)	4.0	2.4
25-29	110.5 (94.3-126.7)		3.1	
30-34	110.4 (88.7-132.1)		4.2	
35-39	112.9 (91.2-134.6)		4.4	
40-44	112.8 (94.1-131.5)		3.7	
45-49	100.8 (78.0-123.6)		4.3	
Males 50-64 R Grip				
50-54	113.6 (95.5-131.7)		3.6	4.0
55-59	101.1 (74.4-127.8)		5.8	
60-64	89.7 (69.3-110.1)		4.2	
Males 50-64 L Grip				
50-54	101.9 (84.9-118.9)		3.4	3.5
55-59	83.2 (59.8-106.6)		5.1	
60-64	76.8 (56.5-97.1)		4.1	

Table 3
Males' Key and 3-Point Pinch Comparison 1985 and 2013 Norms

	1985 U.S. Means and (+- 1 *SD*) [12]	MI 2013 Means and (+- 1 *SD*)	1985 U.S. SE [12]	MI 2013 SE
Males 20-49 R Key Pinch				
20-24	26.0 (22.5-29.5)	27.8 (23.3-32.3)	.65	.55
25-29	26.7 (21.8-31.6)		.94	
30-34	26.4 (21.6-31.2)		.93	
35-39	26.1 (22.9-29.3)		.65	
40-44	25.6 (23.0-28.2)		.50	
45-49	25.8 (21.9-29.7)		.73	
Males 20-49 L Key Pinch				
20-24	24.8 (21.4-28.2)	27.0 (22.9-31.1)	.64	.51
25-29	25.0 (20.6-29.4)		.85	
30-34	26.2 (21.1-31.3)		.98	
35-39	25.6 (21.7-29.5)		.77	
40-44	25.1 (21.1-29.1)		.79	
45-49	24.8 (20.4-29.2)		.84	
Males 50-64 R Key Pinch				
50-54	26.7 (22.3-31.1)	27.3 (22.5-32.1)	.88	.82
55-59	24.2 (20.0-28.4)		.92	
60-64	23.2 (17.8-28.6)		1.13	
Males 50-64 L Key Pinch				
50-54	26.1 (21.9-30.3)	25.9 (20.7-31.1)	.84	.88
55-59	23.0 (18.3-27.7)		1.02	
60-64	22.2 (18.1-26.3)		.84	
Males 20-49 R 3-Point Pinch				
20-24	26.6 (21.1-32.1)	25.1 (20.6-29.6)	1.03	.55
25-29	26.0 (21.7-30.3)		.84	
30-34	24.7 (20.0-29.4)		.91	
35-39	26.2 (22.1-30.3)		.83	
40-44	24.5 (20.2-28.8)		.85	

45-49	24.0 (20.7-27.3)		.63	
Males 20-49 L 3-Point Pinch				
20-24	25.7 (19.9-31.5)	24.1 (20.4-27.8)	1.08	.45
25-29	25.1 (20.9-29.3)		.82	
30-34	25.4 (19.7-31.1)		1.10	
35-39	25.9 (20.5-31.3)		1.17	
40-44	24.8 (19.9-29.7)		.96	
45-49	23.7 (19.9-27.5)		.71	
Males 50-64 R 3-Point Pinch				
50-54	23.8 (18.4-29.2)	22.4 (18.9-25.9)	1.08	.59
55-59	23.7 (18.9-28.5)		1.06	
60-64	21.8 (18.5-25.1)		.67	
Males 50-64 L 3-Point Pinch				
50-54	24.0 (18.2-29.8)	22.5 (18.4-26.6)	1.16	.70
55-59	21.3 (16.8-25.8)		.99	
60-64	21.2 (18.0-24.4)		.65	

Table 4
Females' Grip Strength Mean Comparisons 1985-2013 MI Norms

	1985 U.S. Means and (+-1 *SD*)	MI 2013 Means and (+-1 *SD*)	1985 U.S. SE	MI Norms SE
Females 20-49 R Grip				
20-24	70.4 (55.9-84.9)	68.4 (55.4-81.4)	2.8	1.6
25-29	74.5 (60.6-88.4)		2.7	
30-34	78.7 (59.5-97.9)		3.8	
35-39	74.1 (63.3-84.9)		2.2	
40-44	70.4 (56.9-83.9)		2.4	
45-49	62.2 (47.1- 77.3)		3.0	
Females 20-49 L Grip				
20-24	61.0 (47.9-74.1)	63.5 (51.3-75.7)	2.6	1.5
25-29	63.5 (51.3-75.7)		2.4	
30-34	68.0 (50.3-85.7)		3.5	
35-39	66.3 (54.6-78.0)		2.3	
40-44	62.3 (48.5-76.1)		2.5	
45-49	56.0 (43.3-68.7)		2.5	
Females 50-64 R Grip				
50-54	65.8 (54.2-77.4)	55.2 (43.1-67.3)	2.3	3.2
55-59	57.3 (44.8-69.8)		2.5	
60-64	55.1 (45.0-65.2)		2.0	
Females 50-64 L Grip				
50-54	57.3 (46.6-68.0)	53.2 (39.8-66.6)	2.1	3.6
55-59	47.3 (35.4-59.2)		2.4	
60-64	45.7 (35.6-55.8)		2.0	

Table 5
Females' Key and 3-Point Pinch Comparison 1985 and MI 2013 Norms

	1985 U.S. Means and (+- 1 *SD*)	MI 2013 Means and (+- 1 *SD*)	1985 U.S. SE	MI 2013 SE
Females 20-49 R Key Pinch				
20-24	17.6 (15.6-19.6)	18.8 (16.5-21.1)	.39	.29
25-29	17.7 (15.6-19.8)		.41	
30-34	18.7 (15.7-21.7)		.60	
35-39	16.6 (14.6-18.6)		.40	
40-44	16.7 (13.6-19.8)		.56	
45-49	17.6 (14.4-20.8)		.65	
Females 20-49 L Key Pinch				
20-24	16.2 (14.1-18.3)	17.7 (14.9-20.5)	.41	.36
25-29	16.6 (14.5-18.7)		.41	
30-34	17.8 (14.2-21.4)		.70	
35-39	16.0 (13.3-18.7)		.53	
40-44	15.8 (12.7-18.9)		.55	
45-49	16.6 (13.7-19.5)		.58	
Females 50-64 R Key Pinch				
50-54	16.7 (14.2-19.2)	16.8 (14.1-19.5)	.5	.71
55-59	15.7(13.2-18.2)		.5	
60-64	15.5 (12.8-18.2)		.55	
Females 50-64 L Key Pinch				
50-54	16.1 (13.4-18.8)	16.0 (14.1-17.9)	.53	.51
55-59	14.7 (12.5-16.9)		.44	
60-64	14.1 (11.6-16.6)		.50	
Females 20-49 R 3-Point Pinch				
20-24	17.2 (14.9-19.5)	18.0 (14.5-21.5)	.45	.44
25-29	17.7 (14.5-20.9)		.62	
30-34	19.3 (14.3-24.3)		.99	
35-39	17.5 (13.3-21.7)		.85	
40-44	17.0 (13.9-20.1)		.56	

45-49	17.9 (14.9-20.9)		.60	
Females 20-49 L 3-Point Pinch				
20-24	16.3 (13.5-19.1)	16.8 (13.5-20.1)	.56	.41
25-29	17.0 (14.0-20.0)		.58	
30-34	18.1 (13.3-22.9)		.94	
35-39	17.1 (13.7-20.5)		.68	
40-44	16.6 (13.1-20.1)		.63	
45-49	17.5 (14.7-20.3)		.57	
Females 50-64 R 3-Point Pinch				
50-54	17.3 (14.2-20.4)	15.7 (11.9-19.5)	.63	1.01
55-59	16.0 (12.9-19.1)		.63	
60-64	14.8 (11.7-17.9)		.61	
Females 20-49 L 3 Point Pinch				
50-54	16.4 (13.5-19.3)	15.4 (12.7-18.1)	.59	.72
55-59	15.4 (12.4-18.4)		.61	
60-64	14.3 (11.6-17.0)		.54	

Table 6
MI Updated Male Hand Strength 2013 Norms

Grip Strength

Age	Hand	Mean	Within -1 *SD* +1	*SD*	Norms Collected Low-High	Standard Error
20-49	R	120.2	99.9-140.5	20.3	81.7–185	2.5
	L	115.0	95.7-134.3	19.3	85–188.3	2.4
50-62	R	105.0	81.1-128.9	23.9	61.7-186.7	4.0
	L	103.0	82.5-123.5	20.5	66.7–167.3	3.5

Key Pinch Lateral

Age	Hand	Mean	Within -1 SD +1	SD	Norms Collected Low-High	Standard Error
20-49	R	27.8	23.3-32.3	4.5	15–42.3	.55
	L	27.0	22.9-31.1	4.1	14.7–37.3	.51
50-62	R	27.3	22.5-32.1	4.8	17.3–43.7	.82
	L	25.9	20.7-31.1	5.2	11.3–41.3	.88

3-Point Pinch

Age	Hand	Mean	Within -1 SD +1	SD	Norms Collected Low-High	Standard Error
20-49	R	25.1	20.6-29.6	4.5	14.3–38	.55
	L	24.1	20.4-27.8	3.7	15–32	.45
50-62	R	22.4	18.9-25.9	3.5	14.7–32	.59
	L	22.5	18.4-26.6	4.1	14–35	.70

Table 7
MI Updated Female Hand Strength 2013 Norms

Grip Strength

Age	Hand	Mean	Within -1 *SD* +1	*SD*	Norms Collected Low-High	Standard Error
20-49	R	68.4	55.4-81.4	13	41.7–120	1.6
	L	63.5	51.3-75.7	12.2	41.7–108	1.5
50-62	R	55.2	43.1-67.3	12.1	36.7–81.7	3.2
	L	53.2	39.8-66.6	13.4	33.3–81.7	3.6

Key Pinch Lateral

Age	Hand	Mean	Within -1 *SD* +1	*SD*	Norms Collected Low-High	Standard Error
20-49	R	18.8	16.5-21.1	2.3	13.3–25	.29
	L	17.7	14.9-20.5	2.8	8–24.7	.36
50-62	R	16.8	14.1-19.5	2.7	13.7–22	.71
	L	16.0	14.1-17.9	1.9	12–20.7	.51

3-Point Pinch

Age	Hand	Mean	Within -1 *SD* +1	*SD*	Norms Collected Low-High	Standard Error
20-49	R	18	14.5-21.5	3.5	11.7–31	.44
	L	16.8	13.5-20.1	3.3	8.7–31.7	.41
50-62	R	15.7	11.9-19.5	3.8	10–23.3	1.01
	L	15.4	12.7-18.1	2.7	11.3–19.3	.72

Discussion

This sample of Michigan workers provides recent norms that a therapist could use to compare their client's grip and pinch strength to other workers ages 20 to 62 years. By combing the age categories into the larger categories, the MI 2013 norms for ages 20 to 49 years have lower Standard Error (SE) scores than the 1985 norms (Mathiowetz et al., 1985) for both the males and females in the category of ages 20 to 49 years. The lower SE and more recent data collection give stronger evidence for using the MI 2013 norms than the 1985 norms. The SE for males ages 50 to 62 years was 4.0 compared to the 1985 norms' SE of 3.6 (ages 50 to 54 years), 5.8 (ages 55 to 59 years) and 4.2 (ages 60 to 64 years). The 2013 and 1985 SE are comparable for this age group, giving a therapist as much confidence in the 2013 MI norms as the 1985 norms. The SE for the norms for females ages 50 to 62 years was 3.2 for the MI 2013 norms; this is higher than the SE for those age groups in the 1985 norms (2.3, 2.5, and 2.0 for the age groups 50 to 54, 55 to 59, and 60 to 64 years, respectively). This gives less confidence for the 2013 norms for this age group, but even with the SE at 3.2, it is still lower than the SE for the males ages 50 to 65 years in the 1985 study. The higher SE may cause therapists to be less confident about using the norms for this one age group because of the small sample size and the high SE. The small sample size may cause the higher SE as well as the findings that some women ages 50 to 62 years may have already begun to experience arthritic changes in their hands, which may have caused some of them to lose strength in their hands prematurely (My Cleveland Clinic, 2013).

Limitations of this study include the small sample size overall and the especially small sample size for workers ages 50 to 62 years, and because the standard position of the dynamometer at the 2nd setting (following ASHT standards) was used, this setting may not be the best "fit" for some people, although following this protocol allows a standardized testing procedure.

Conclusion

As long as grip strength is being tested as a part of therapeutic intervention, it is important to have current norms available for comparison. As hand usage changes and the tools and world we live in change, normative hand strength data should be reassessed periodically to ensure that the norms used are relevant. Since how we use our hands changes as technology advances, our general hand strength may eventually transform, as well.

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